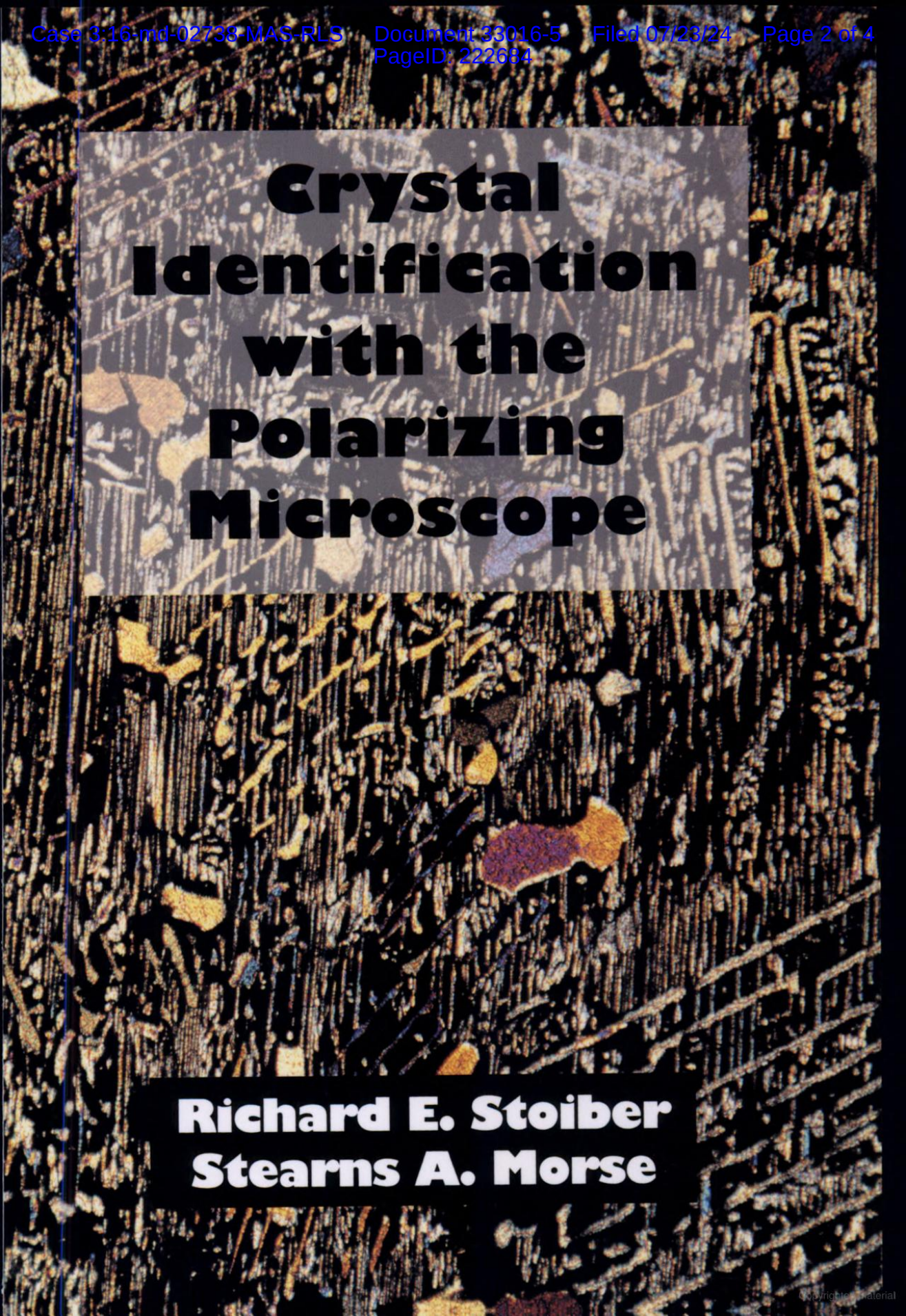
Exhibit 65



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Crystal Identification with the Polarizing Microscope

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normal to the wave propagation directions, will be parallel to the surface of the plate.

3. The vibration planes of the polarized components being normal to each other, the vibration directions in the plane of the plate lie in these planes and are normal to each other.
4. Wave propagation directions of both components being coincident, vibration directions, being normal to each other, can be studied separately.
5. Each vibration direction is related to a propagation direction and this in turn to a refractive index so that the vibration directions may be correlated with refractive index.

For these reasons, **attention most often need only be directed to the vibration directions in anisotropic material,** seldom to the ray directions or the wave propagation directions. We shall concentrate on the vibration directions.

Double Refraction and Birefringence

Anisotropic crystals exhibit *double refraction*, which refers to the fact that each ray of light in such crystals (and the wave propagation directions except when light enters with perpendicular incidence) is refracted by a different amount. The calcite experiment (p. 12) illustrates double refraction. Birefringence, abbreviated as B or δ, is the measure of double refraction in terms of the difference in refractive index.

The *birefringence of a substance* may be defined as in equation 1-13, where the subscripts h and l signify "highest"

$$B = |n_h - n_l| \tag{1-13}$$

and "lowest." The birefringence of a substance (or crystal species) is therefore the maximum difference in refractive indices. This expression is also valid for the partial birefringence of any section or fragment of a crystal, in which case n_h and n_l refer to the higher and lower refractive indices, each associated with one of the two vibration directions normal to a specified wave propagation direction. In practice, this propagation direction is usually incident normal to the crystal boundary and parallel to the axis of the microscope, so the two vibration directions lie in the plane of the microscope stage. Since n_h and n_l for a random section are generally not the same as those for the substance itself, the birefringence of a section is generally less than that of the substance. Because waves propagated along an optic axis all travel with the same velocity, some sections of anisotropic crystals are not birefringent.

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